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Irregular Growth of Outplanted Red Pine
V. A Comparison Between Seedling and Transplant Stock

by

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Unsatisfactory growth and survival of freshly lifted red pine (*Pinus resinosa* Ait.) seedlings outplanted in the field during recent years has been described previously (Glerum *et al.* 1977, Fayle and Pierpoint 1978). The irregular growth involves abnormal development of the terminal leader on some of the surviving seedlings. It may range from a non- or barely-elongated "silver-bud" to an elongated leader with deficient needle development.

Several factors that could influence this irregular performance have been examined to date but the cause of the problem is not clear. No definite herbicide influence was found (Glerum *et al.* 1977). However, the combination of transporting, handling and planting techniques was found to contribute significantly to a reduced performance of outplanted seedlings (Pierpoint *et al.* 1978).

In all these tests 3+0 red pine seedling stock had been used. The question was raised whether or not other age classes would show similar growth irregularities. Therefore, in the spring of 1978 several age classes of red pine (3+0, 1+2, 2+1 and 2+2) were tested in a seedling versus transplant comparison. This outplanting also provided the opportunity to evaluate the new 1+2 age class. The first year results of this comparative outplanting are presented in this note.

Procedures

In the spring of 1978 about 1100 red pine (seedlot 6200) per age class were obtained from Orono and Midhurst nurseries. Three age classes, 3+0, 2+2 and 1+2 came from both nurseries, with an extra age class, 2+1, being added from Orono. Four bundles of 25 trees were randomly selected from each age class and nursery for oven-dry weight top-root ratio determination. Of the remaining trees, 500 from each age class and nursery were outplanted in a shallowly furrowed field of fine sand at Vivian Forest (Lat. N. 44°03', Long. 79°18') about 50 km northeast of Toronto. The other 500 trees from each age class and nursery were outplanted in a shallowly furrowed field of fine sand at Larose forest (Lat. N. 45°25', Long. 75°01') about 65 km southeast of Ottawa. Both outplantings were in the form of a randomized replicated block design with 100 trees per age class per nursery per plot and replicated five times.

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The survival percentages were subjected to analyses of variance after transformation by arcsin-square root. Height growth data were also subjected to analyses of variance because correlations between 1977 height growth in the nursery and 1978 height growth after outplanting were not significant. Consequently, analyses of covariance were deemed unnecessary. All further comparisons were done with the t-test.

Results and Discussion

The first year survival results are given in Table 1. Highly significant differences in survival occurred between all four age classes from Orono at both plantations, while only one age class was significantly different among the three from Midhurst. On a survival basis, the transplant stock performed significantly better than the 3+0 seedling stock. This is particularly true with the 1+2 and 2+2 transplants from Orono.

The first year height growth after outplanting is given in Figure 1. Analyses of variance and t-tests indicated that highly significant differences occurred between age classes, and that the differences between age classes for each nursery at both plantations were highly significant.

The height growth of each age class at both Vivian and Larose Forests is similar. This is somewhat surprising, since below normal summer precipitation occurred at Vivian Forest while at Larose Forest summer precipitation was about normal. This similarity in growth is probably due to the fact that the amount of shoot elongation in red pine is largely predetermined in the bud, which was formed the previous year.

The 1+2 Orono age class had a significantly better height increment than the 2+2 age class, while the reverse occurred with the Midhurst stock. However, both of these age classes from both nurseries performed significantly better than the 3+0 age class. The 2+1 age class performed least, probably due to an adverse effect of transplanting in two consecutive years. In general, the irregular growth observed after outplanting in the 3+0 age class was somewhat greater than that in the 1+2 and 2+2 age classes.

TABLE 1 Average first year survival (in percent) of several age classes of red pine from two nurseries at two locations*

Age class	Vivian Forest		Larose Forest	
	Orono nursery	Midhurst nursery	Orono nursery	Midhurst nursery
1+2	91.6a	94.8a	94.6a	99.8a
2+2	83.4b	94.2a	85.2b	99.4a
2+1	76.4c	-	83.8c	-
3+0	70.8d	93.0a	79.4d	93.6b

*The survival figures in the columns not followed by the same letter differ significantly from each other at the 1.0% level.

TABLE 2 Top-root ratios, based on oven-dry weight, of several age classes of red pine from Orono and Midhurst Nurseries

Age class	Top-root ratio	
	Orono	Midhurst
3+0	6.08	5.61
2+2	4.46	4.68
2+1	3.79	--
1+2	3.30	4.38

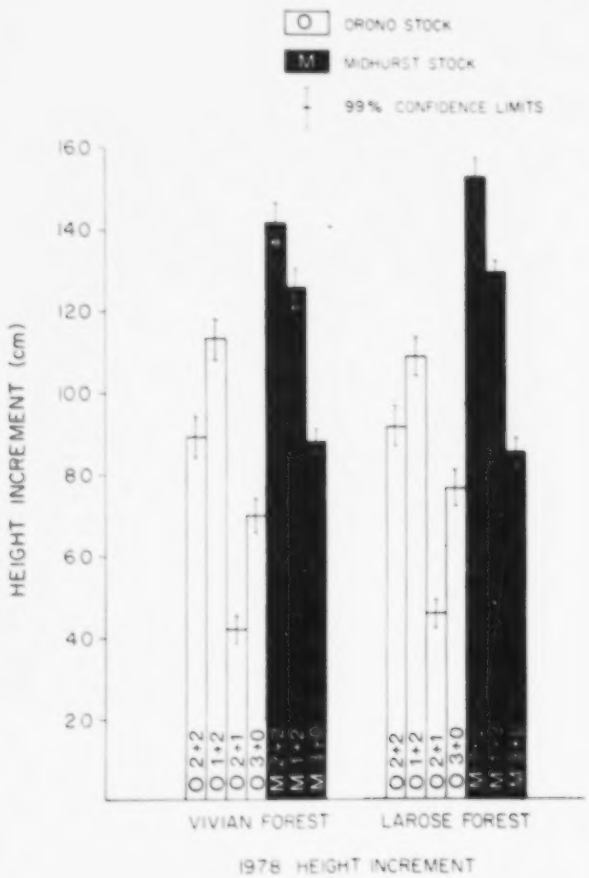

FIGURE 1 The average first year height increment of the various red pine age classes from Orono and Midhurst nurseries, outplanted at Vivian and Larose Forests. The variation within the data is reflected by the confidence limits.

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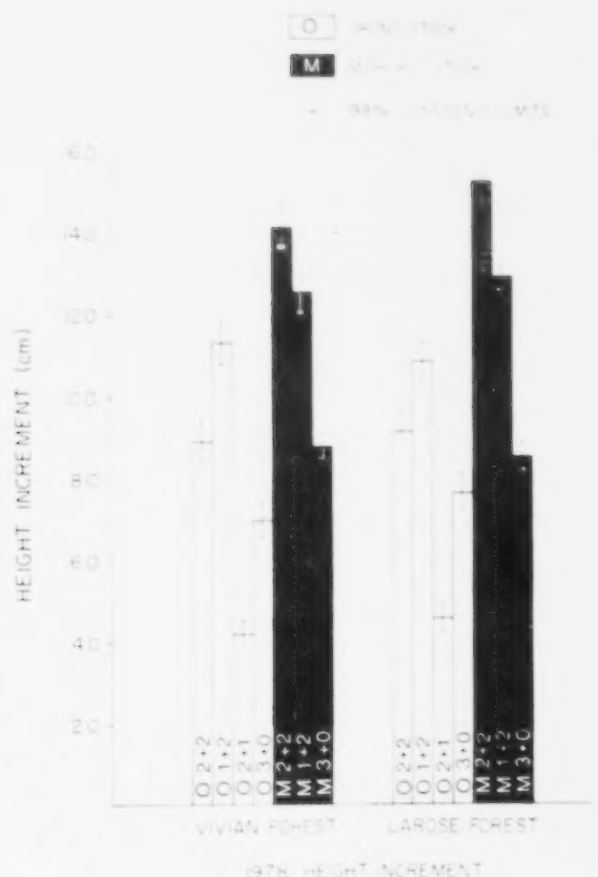

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It was noted at the time of planting that the roots of the Orono 2+2 age class had a pronounced "hockey stock" development; it was considerably less pronounced in the Orono 1+2 age class. This might explain in part why the Orono 2+2 age class performed more poorly than the 1+2 age class. The Midhurst stock had a normal fibrous root system.

The top-root ratio (Table 2) for the 3+0 age class was considerably higher than those of the 2+2 and 1+2 age classes, explaining in part why the 3+0 age class performed significantly less than the other two age classes. However, the poor performance of the 2+1 age class cannot be explained by its top-root ratio, which appears favourable. This demonstrates clearly the contention, mentioned elsewhere (Glerum and Boufford 1979), that top-root ratio should never be used as the only parameter to characterize nursery stock. Similarly, survival as a measure of successful planting is deceptive and should be qualified with at least one other parameter, such as height growth.

Our first year results, and they should be considered only as such, are remarkably similar to those of Mullin who conducted extensive comparisons between seedlings and transplants in the 1960's (Mullin and Howard 1973). He found that 2+2 stock performed significantly better than 3+0 stock. Furthermore, these findings are consistent with those of many other investigators throughout the world.

The 1+2 age class is new to Ontario and its performance deserves careful monitoring. It has several advantages over the 2+2 age class. It is cheaper to grow, easier to handle and plant because of its more compact size and it is still a well-balanced tree. Successive years' remeasurements will determine whether or not these first year significant differences persist.

Acknowledgement

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References

FAYLE, D.C.F. and G. PIERPOINT. 1978. Interpreting performance of recently outplanted pine seedlings. *In* White and red pine symposium, Chalk River, Ont. Sept. 1977. Environ. Can., Can. Forest. Serv., Symp. Proc. O-P-6. p. 113-121.

GLERUM, C. and J.G. BOUFFORD. 1979. A comparison between top-root ratio determinations by oven-dry weight and volume displacement. Ont. Min. Natur. Resour., Forest Res. Note No. 22. 4 p.

GLERUM, C., J.G. BOUFFORD and J.M. PATERSON. 1977. Irregular growth of outplanted red pine. I. The influence of nursery herbicidal practices. Ont. Min. Natur. Resour., Forest Res. Note No. 5. 4 p.

MULLIN, R.E. and C.P. HOWARD. 1973. Transplants do better than seedlings and... Forest. Chron. 49: 213-218.

PIERPOINT, G., J.M. PATERSON, J.G. BOUFFORD and C. GLERUM. 1978. Irregular growth of outplanted red pine. III. The influence of handling and planting on second-year performance. Ont. Min. Natur. Resour., Forest Res. Note No. 14. 4 p.